



## **2015 PERFORMANCE MONITORING WP FOR SELECTED SUB-WATERSHEDS**

PREPARED BY

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# TITLE AND APPROVAL SHEET (QAPP Element A1)

## 2015 PERFORMANCE MONITORING WORK PLAN FOR SELECTED SUB-WATERSHEDS

Indiana Department of Environmental Management


Office of Water Quality

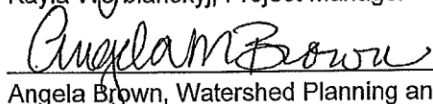
Watershed Assessment & Planning Branch

Indianapolis, Indiana


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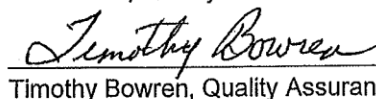
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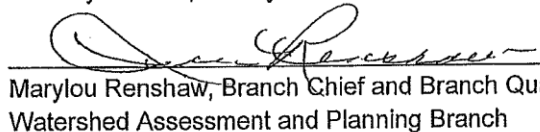
 Date 7/7/15  
Kayla Werbianskyj, Project Manager

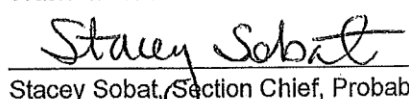
 Date 7/9/15  
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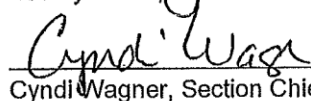
### Reviews and Approvals

 Date 7/1/15  
Chuck Bell, Quality Assurance Manager, Technical and Logistical Services Section

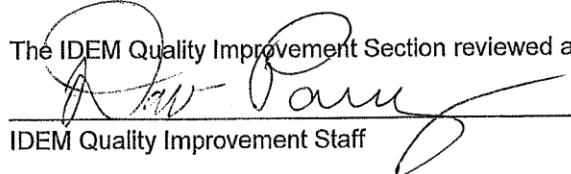
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Watershed Assessment and Planning Branch

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Cyndi Wagner, Section Chief, Targeted Monitoring Section

The IDEM Quality Improvement Section reviewed and approves this Sampling and Analysis Workplan.

 Date 7/9/15  
IDEM Quality Improvement Staff

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## FOREWORD

### **Work Plan versus QAPP:**

This Sampling and Analysis Work Plan is an extension of the existing Watershed Assessment and Planning Branch, October 2004 “*Quality Assurance Project Plan (QAPP) for Indiana Surface Water Quality Monitoring and Total Maximum Daily Load (TMDL) Program*” and serves as a link to the existing QAPP as well as an independent QAPP of the project. As per the United States Environmental Protection Agency (U.S. EPA) QAPP guidance, this Work Plan establishes criteria and specifications pertaining to a specific water quality monitoring project that are usually described in the following four groups (phases) or sections as QAPP elements:

#### **Phase A. Project Management/Planning**

The plan documents project history and objectives, and establishes Data Quality Objectives (DQOs).

#### **Phase B. Measurement/Data Acquisition**

The plan describes sampling procedures, analytical methods, sample and data acquisition requirements, and the quality control (QC) measures specific to the project.

#### **Phase C. Assessment/Oversight**

The plan identifies the key elements of external and internal checks, audits, peer reviews, Data Quality Assessments (DQAs), and the preparation of Quality Assurance/Quality Control (QA/QC) Review Reports for management.

#### **Phase D. Data Validation and Usability**

The plan describes data handling and associated QA/QC activities including QA/QC Review Reports.

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## List of Acronyms

AIMS:	Assessment Information Management System
AUID:	Assessment Unit Identification
CALM:	Consolidated Assessment Listing Methodology
CFR:	Code of Federal Regulations
CPR:	Cardio-Pulmonary Resuscitation
DO:	Dissolved Oxygen
DQA:	Data Quality Assessment
DQO:	Data Quality Objectives
GPS:	Global Positioning System
IAC:	Indiana Administrative Code
IBC:	Impaired Biotic Community
IBI:	Index of Biotic Integrity
IC:	Indiana Code
IDEM:	Indiana Department of Environmental Management
MDL:	Method Detection Limit
mg/L:	Milligram per liter
MHAB:	Multi-habitat
mL:	Milliliter
mm:	Millimeters
NPS:	Nonpoint Source Control
NTU:	Nephelometric Turbidity Unit(s)
OHEPA	Ohio Environmental Protection Agency
OWQ:	Office of Water Quality
PFD:	Personal Floatation Device
PPE:	Personal Protective Equipment
QA/QC:	Quality Assurance/Quality Control
QAPP:	Quality Assurance Project Plan
QC:	Quality Control
QHEI:	Qualitative Habitat Evaluation Index
RL:	Reporting Limit
RPD:	Relative Percent Difference
SM:	Standard Method
SOLAS:	Safety of Life at Sea
SOP:	Standard Operating Procedures
S.U.:	Standard Units
TMDL:	Total Maximum Daily Load
U.S. EPA:	United States Environmental Protection Agency
WAPB:	Watershed Assessment and Planning Branch

## Definitions:

Impaired Biotic Communities	Biological communities – the fish and aquatic invertebrates, such as insects, in stream – are indicators of the cumulative effects of activities that affect water quality conditions over time. An IBC listing on Indiana's 303(d) list, means IDEM'S monitoring data shows one or both of the aquatic communities are not as healthy as they should be. IBC is not a source of impairment but a symptom of other sources.
Elutriate	To purify, separate, or remove lighter or finer particles by washing, decanting, and settling.
Fifteen (15) Minute Pick	A component of the IDEM multihabitat macroinvertebrate sampling method in which the one minute kick sample and fifty meter sweep sample collected at a site are combined, elutriated, with macroinvertebrates removed from the resulting sample for 15 minutes while in the field.
Fifty (50) Meter Sweep	A component of the IDEM multihabitat macroinvertebrate sampling method in which approximately 50 meters (50m) of shoreline habitat in a stream or river is sampled with a standard 500 micrometer (500 $\mu$ m) mesh width D-frame dipnet by taking 20-25 individual "jab" or "sweep" samples, which are then composited.
One (1) minute kick sample	A component of the IDEM multihabitat macroinvertebrate sampling method in which approximately one square meter (1 m <sup>2</sup> ) of riffle or run substrate habitat in a stream or river is sampled with a standard 500 micrometer (500 $\mu$ m) mesh width D-frame dipnet for approximately one (1) minute.
Ocular Reticule	A thin piece of glass marked with a linear or areal scale that is inserted into a microscope ocular, superimposing the scale onto the image viewed through the microscope.
Perennial	Water being present in at least 50% of the stream reach during the time of fish community sampling.
Reach	A segment of a stream used for fish community sampling equal in length to 15 times the average wetted width of the stream, with a minimum length of 50 meters and a maximum length 500 meters.
Target	A sampling point which falls on a perennial stream within the basin of interest and the boundaries of Indiana.

## PERFORMANCE MONITORING IN SELECTED WATERSHEDS; OBJECTIVE

Performance monitoring is initiated when waterbodies cited on the Indiana 303(d) list as impaired have documented Nonpoint Source (NPS) control or watershed planning and restoration efforts. This type of monitoring provides chemical, physical, biological, and/or bacteriological data that can be reported to U.S. EPA Region 5's NPS Program showing improvements in watersheds previously listed as impaired. The monitoring design for each waterbody reflects the original sampling effort that was conducted; no new sites were selected or added. In 2015 there will be performance monitoring efforts on three waterbodies: Silver Creek, Flowers Creek, and Indian Creek. Sample sites will be monitored to confirm or deny the designated impairment and possible improvement due to NPS funding of watershed management plan implementation. It is anticipated that the water quality data collected will highlight improvements in watersheds such that waterbodies previously identified as impaired are now meeting water quality standards.

Previous sampling (2003, 2010) on Silver Creek (Silver Creek Watershed, HUC 051201040501) indicated a bacteriological impairment for *Escherichia coli* (*E. coli*). In 2015, site 15W002 will be targeted for *E. coli* on AUID segment INB0451\_02.

Two sites (15W003 and 15W004) in the Flowers Creek-Eel River Watershed, HUC 051201040601, will be sampled for performance monitoring on the same AUID segment INB0461\_T1005. Previous sampling in 2003 on AUID segment INB0461\_T1005 indicated an impaired biotic community (IBC) and impairments for dissolved oxygen (DO) and nutrients. In 2015, site 15W003 will be targeted for biotic communities (with *in situ* field chemistry), nutrients, and Dissolved Oxygen. Site 15W004 on Flowers Creek is one of the randomly selected sites in 2015 for the Probabilistic Monitoring Program. Since it falls on AUID segment INB0461\_T1005, it will be sampled for the same parameters and data collected will also be used to support performance monitoring in this watershed.

Previous sampling (2005, 2010) on Indian Creek (Long Run-Indian Creek Watershed, HUC 050902030902) indicated an IBC. In 2015, site 15W005 will be targeted for biotic community (with *in-situ* field chemistry) on AUID segment INV0392\_02.

## I. PROJECT MANAGEMENT/PLANNING (QAPP Elements A4, A5, A6, A7, A8)

### Project/Task Organization and Schedule: (QAPP Element A4)

Sampling of waterbodies in the Flowers Creek-Eel River Watershed, Long Run-Indian Creek Watershed, and Silver Creek Watershed will occur between April and October during the 2015 sampling season. Deadlines and time frames for sampling activities listed below are relative to the cause of impairment per watershed:

Site reconnaissance activities for all watersheds will be completed in March 2015 to seek land owner approval to access the stream safely with the appropriate equipment. Reconnaissance activities will be conducted in the office and through physical site visits if needed.

Biological sampling for Flowers Creek (AUID INB0461\_T1005) and Indian Creek (AUID INV0392\_02) will begin in July 2015 and end no later than October 17, 2015. The sites will be sampled once for *in-situ* water chemistry parameters, fish community, macroinvertebrate community, and habitat quality.

Bacteriological sampling for Silver Creek (AUID INB0451\_02) will begin in April 2015. *E. coli* samples will be collected five times at equally spaced intervals over a 30-day period during the recreational season of April to October 2015 to determine a geometric mean.

Water Chemistry (Nutrients)--Ammonia, Phosphorus, and Nitrogen will be sampled on three discrete occasions at target sites in Flowers Creek (AUID INB0461\_T1005) with a minimum time frame of 30 days between sampling events. The first event will take place in May, the second event in July, and the final event will begin in September.

In situ Water Chemistry—Dissolved Oxygen, Dissolved Oxygen Percent, Saturation, pH, Temperature, Turbidity will be collected with each biological and nutrient sampling event for target sites in Flowers Creek.

**Table 1. 2015 Performance monitoring deadlines and time frames for sampling activities relative to the cause of impairment per stream in selected sub-watersheds**

2015	Reconnaissance	<i>E.coli</i>	Nutrients	IBC	In situ Water Chemistry
Silver Creek	March	April-June	X	X	Every Sampling Event
Wilson-Rhodes Ditch	March	X	May-Oct 17	Jun-Oct 17	Every Sampling Event
Flowers Creek	March	X	May-Oct 17	Jun-Oct 17	Every Sampling Event
Indian Creek	March	X	X	Jun-Oct 17	Every Sampling Event

- "X" denotes that site was not sampled for the corresponding parameter

Samples will be collected for physical, chemical, and biological communities if the flow is not dangerous for staff to enter the stream and barring any hazardous weather conditions or unexpected physical barriers to site access. Even if the weather conditions and stream flows are safe, sample collections for biological communities may also be postponed at least one week due to scouring of the stream substrate or instream cover following a high water event resulting in non-representative samples.

### **Background and Project/Task Description: (QAPP Elements A5, A6)**

Performance Monitoring was instituted to show improvements in watersheds that have implemented watershed planning and restoration activities. The objective of this project is to collect data on waterbodies in Silver Creek, Flowers Creek-Eel River, and Long Run-Indian Creek Watersheds that have documented impairments reflected in the 303(d) list that may now have the potential of meeting water quality standards. For this study, the following media will be used for assessment purposes: Water chemistry (Nutrients and DO), *in-situ* field chemistry, bacteriological contamination in the form of *E. coli*, fish community, macroinvertebrate assemblages, and habitat evaluations. The monitoring design for each waterbody reflects the original sampling effort that was conducted; no new sites were selected or added.

### **Data Quality Objectives (DQOs): (QAPP Element A7)**

The DQO process (U.S. EPA 2006) is a planning tool for data collection activities. It provides a basis for balancing decision uncertainty with available resources. The DQO is required for all significant data collection efforts for a project. It is a seven step systematic planning process used to clarify study objectives, define the appropriate types of data, and establish decision criteria on which to base the final use of the data. The DQO for Performance Monitoring in Silver Creek, Flowers Creek-Eel River, and Long Run-Indian Creek Watersheds is identified in the following seven steps:

#### *1. Description of the Problem*

Indiana is required to assess all waters of the state to determine their designated use attainment status. "Surface waters of the state are designated for full body contact recreation" and "will be capable of

supporting” a “well-balanced, warm water aquatic community” [327 IAC 2-1-3]. This project will gather bacteriological, biological (fish and macroinvertebrate) and habitat, and/or chemical data for the purpose of reassessing the designated use attainment status of the impaired AUID segments on Silver Creek, Flowers Creek, and Indian Creek.

## *2. Identify the Decision for the Data Collection*

The goal of this study is to reassess whether the targeted stream segments on Silver Creek, Flowers Creek, and Indian Creek (Table 2) are “supporting” or “non-supporting” for the designated use attainment related to each previously identified impairment. This comparison will be in correlation with water quality criteria included in Table 3 [327 IAC 2-1-6], nutrient criteria, and/or biological criteria following Indiana’s 2014 Consolidated Assessment Listing Methodology (CALM, IDEM 2014).

For Flowers Creek AUID stream segment INB0461\_T1005, two sites will be evaluated for biological improvement (Table 2 and Biological Criteria). The second site will also be evaluated for dissolved oxygen (Table 2, 3) and nutrients with the benchmarks listed in the nutrient benchmarks section below (IDEM 2014). Indian Creek AUID stream segment INV0392\_02 will have one site evaluated for biological improvement (Table 2 and Biological Criteria). Silver Creek AUID stream segment INB0451\_02 will be evaluated for bacteriological improvement (Table 2, 3).

### Nutrient Benchmarks

Assuming a minimum of three sampling events, if two or more of the conditions below are met on the same date, the waterbody will be classified as non-supporting due to nutrients.

- Total Phosphorus: one or more measurements >0.3 mg/L
- Nitrogen (measured as NO<sub>3</sub>+NO<sub>2</sub>): one or more measurements >10.0 mg/L
- Dissolved Oxygen: <4.0 mg/L or measurements consistently at or close to the standard, range 4.0-5.0 mg/L or >12.0 mg/L
- pH: >9.0 Standard Units (S.U.) or measurements consistently at or close to the standard, range 8.7-9.0 S.U.

### Biological Criteria:

Indiana narrative biological criteria [327 IAC 2-1-3] states that “all waters, except as described in subdivision (5),” (i.e., limited use waters) “will be capable of supporting” a “well-balanced, warm water aquatic community.” The water quality standard definition of a “well-balanced aquatic community” is “an aquatic community that: (A) is diverse in species composition; (B) contains several different trophic levels; and (C) is not composed mainly of pollution tolerant species” [327 IAC 2-1-9]. An interpretation or translation of narrative biological criteria into numeric criteria would be as follows: A stream segment is non-supporting for aquatic life use when the monitored fish or macroinvertebrate community receives an Index of Biotic Integrity (IBI) score of less than or equal to 35 which is considered “Poor” or “Very Poor” (IDEM 2014).

**Table 2. List of 2015 Performance Monitoring AUID stream segments and impairments**

Watershed	Stream name	AUID	12 Digit HUC	Impairment
Flowers Creek-Eel River	Flowers Creek	INB0461_T1005	051201040601	Impaired Biotic Community, Nutrients, DO
Flowers Creek-Eel River	Wilson Rhodes Ditch	INB0461_T1005	051201040601	Impaired Biotic Community
Long Run-Indian Creek	Indian Creek	INV0392_02	050902030902	Impaired Biotic Community
Silver Creek	Silver Creek	INB0451_02	051201040501	<i>E. coli</i>

**Table 3. Water Quality Criteria [327 IAC 2-1-6]**

Parameter	Level	Criterion
Dissolved Oxygen	At least 5.0 mg/L (warm water aquatic life) At least 6.0 mg/L (cold-water fish*)	Not less than 4.0 mg/L at any time.  Not less than 6.0 mg/L at any time and shall not be less than 7.0 mg/L in areas where spawning occurs during the spawning season and in areas used for imprinting during the time salmonids are being imprinted.
pH	6.0 - 9.0 S.U.	Must remain between 6.0 and 9.0 S.U. except for daily fluctuations that exceed 9.0 due to photosynthetic activity
Total Ammonia (NH <sub>3</sub> -N)	Calculated based on pH and Temperature	Calculated CAC
<i>E. coli</i> (April-October Recreational season)	125 CFU/100mL or 125 MPN/100 mL  235 CFU/100 mL or 235 MPN/100 mL	5 sample geometric mean based on at least 5 samples equally spaced over a 30 day period  Not to exceed in any one sample in a 30 day period except in cases where there are at least 10 samples, 10% of the samples may exceed the criterion

CAC = Chronic Aquatic Criterion, S.U. = Standard Units, MPN = Most Probable Number, CFU = Colony Forming Unit

\*Waters protected for cold-water fish include those waters designated by the Indiana Department of Natural Resources for put-and-take trout fishing as well as salmonid waters listed in 327 IAC 2-1.5-5.

### 3. Inputs to the Decision

Field monitoring activities are required to collect physical, chemical, biological and habitat data. These data are required to address the necessary decisions previously described. Monitoring activities will take place at previously sampled site (with the exception of 15W004) for which permission to access has been granted by the necessary landowners or property managers. Site 15W004 is a site that was randomly selected as part of the 2015 Probabilistic Monitoring Project (PMP); the data collected at this site for PMP will also be used in this project to reassess AUID segment INB0461\_T1005. Permission to access site 15W004 was granted through the procedures outlined in the 2015 Probabilistic Monitoring Workplan. Collection procedures for field measurements, chemical, biological and habitat data will be described in detail under Section II MEASUREMENT/DATA ACQUISITION.

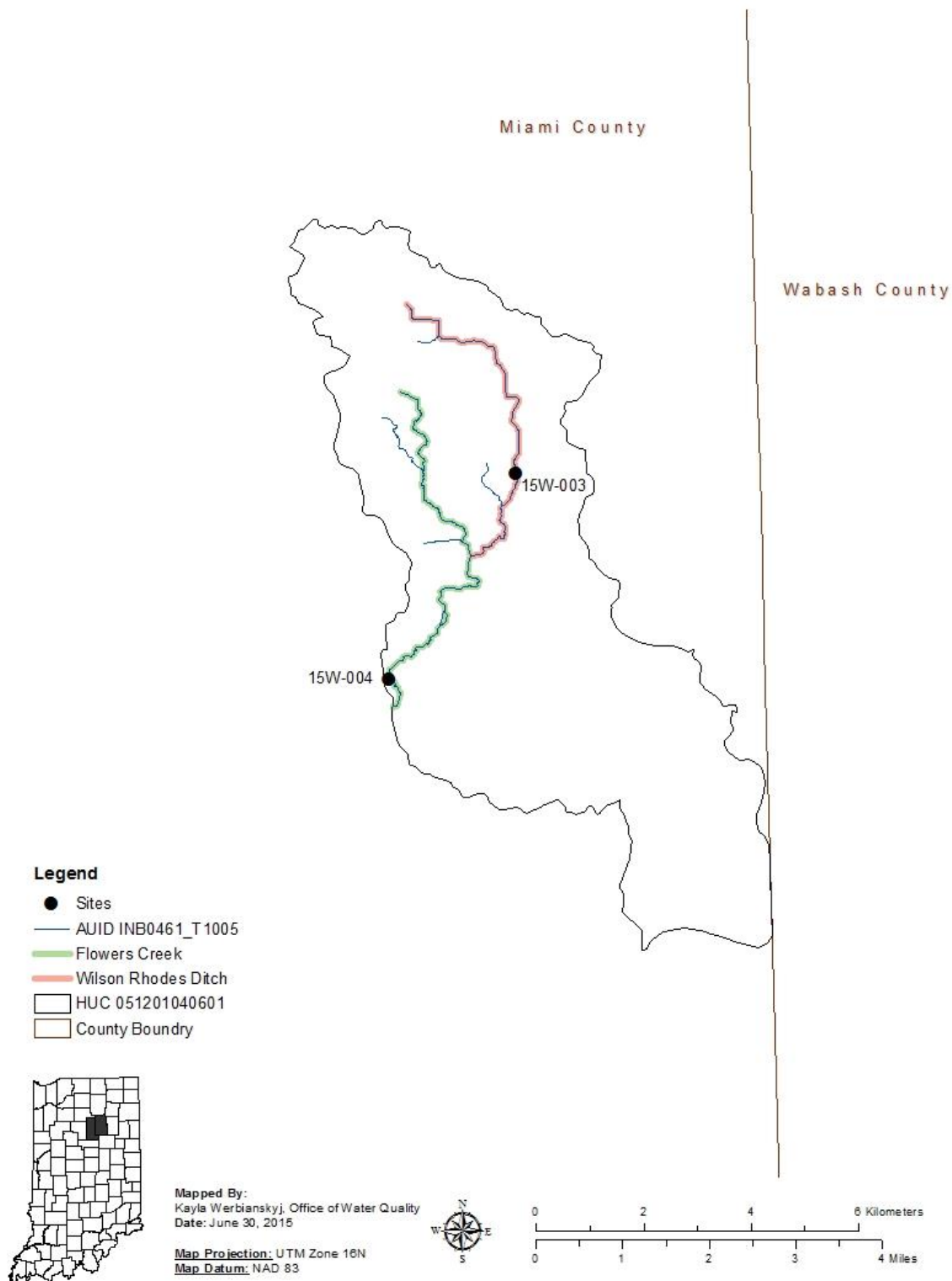
*4. Define the Boundaries of the Study*

The Silver Creek watershed covers 31.5 square miles and is primarily located in Kosciusko and Wabash Counties, with a small portion of the watershed extending into Fulton and Miami County; there is one sampling site (Figure 1). The Flowers Creek-Eel River watershed covers 21.2 square miles and is located in Miami County; there are two sampling sites (Figure 1). The Long Run-Indian Creek watershed covers 38.8 square miles and is located in Switzerland County; there is one sampling site (Figure 2). See Table 4 for sampling locations in all Performance Monitoring watersheds.

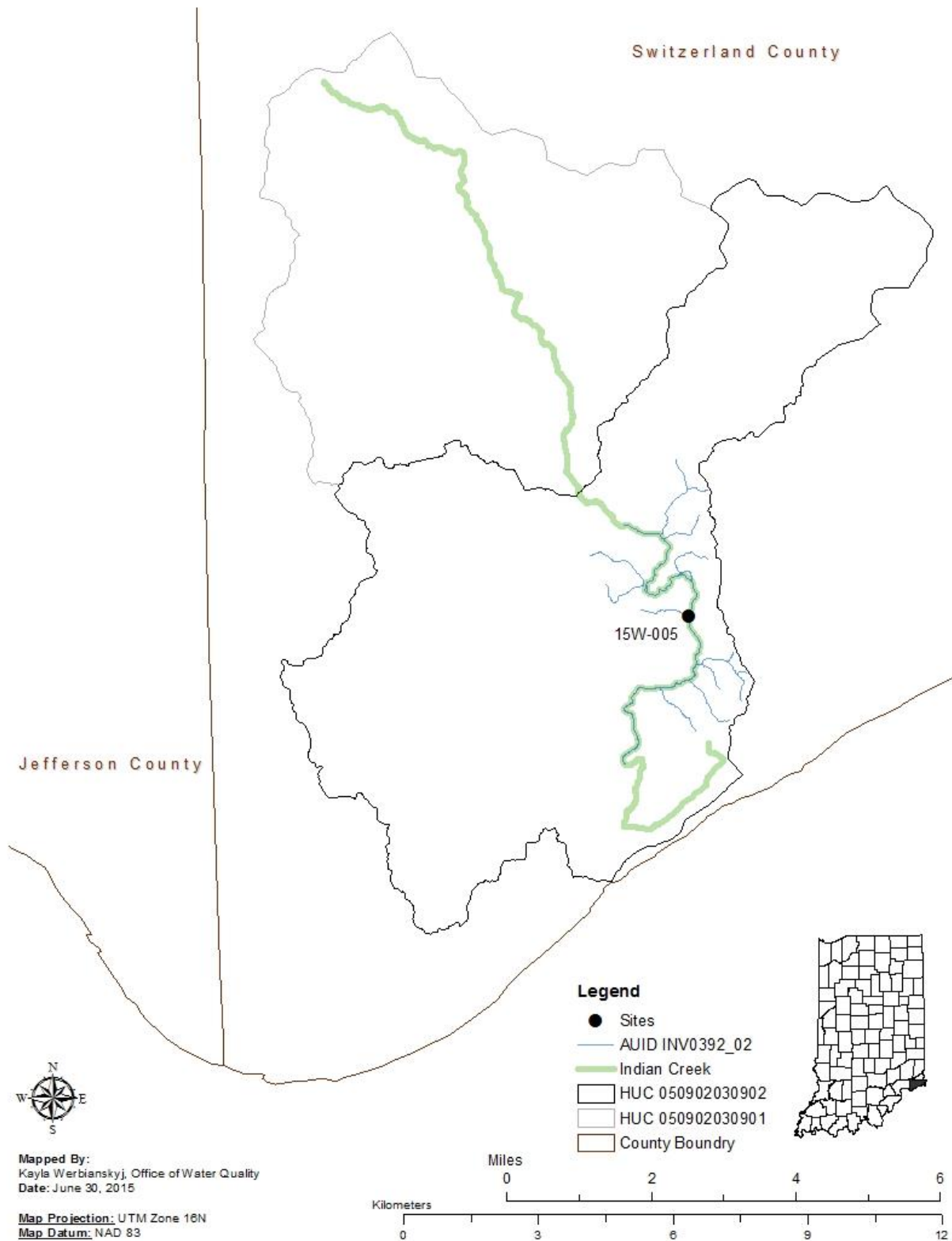
**Table 4. Performance monitoring sampling sites in Silver Creek, Flowers Creek-Eel River, and Long Run-Indian Creek watersheds**

Site #	AIMS #	12-Digit HUC Name	Stream Name	Location	County	Latitude	Longitude
15W-002	WAE-05-0002	Silver Creek	Silver Creek	CR 1000 N	Wabash	40.968991	-85.862136
15W-003	WAE060-0007	Flowers Creek- Eel River	Wilson Rhodes Ditch	Warsaw Trail	Miami	40.896107	-85.997692
15W-004	WAE-06-0004	Flowers Creek- Eel River	Flowers Creek	Broadway Street	Miami	40.861855	-86.026197
15W-005	OML200-0018	Long Run-Indian Creek	Indian Creek	Posten Road	Switzerland	38.779601	-85.079962

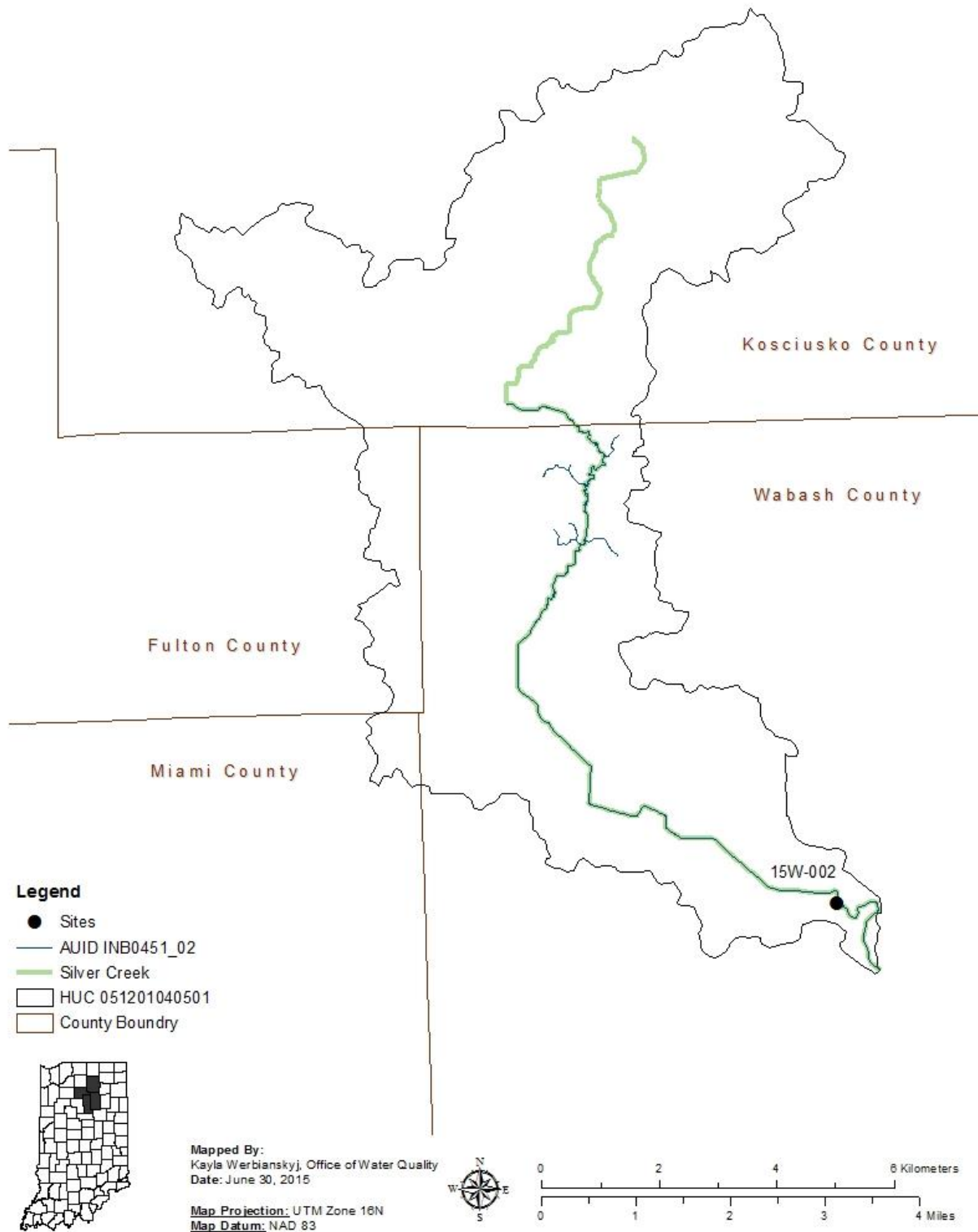
**Figure 1. Performance monitoring sampling area (HUC 051201040601) for IBC, Nutrients, Dissolved Oxygen on Wilson Rhodes Ditch-Flowers Creek AUID INB0461\_T1005**



**Figure 2. Performance monitoring sampling area (HUC 050902030902) for IBC on Indian Creek  
AUID INV0392\_02**



**Figure 3. Performance monitoring sampling area (HUC 051201040501) for *E. coli* on Silver Creek  
AUID INB0451\_02**



#### *5. Develop a Decision Rule*

Assessment decisions (305(b)/303(d)) will be recorded in the Indiana Integrated Report (IDEM 2014). Recreational use attainment decisions will be based on bacteriological criteria developed to protect primary contact recreational activities [327 IAC 2-1-6]. Aquatic life use support decisions will include independent evaluations of biological and chemical data as outlined in Indiana's 2014 Consolidated Assessment and Listing Methodology (CALM, IDEM 2014).

The fish assemblage will be evaluated at each site using the appropriate IBI (Simon 1997; Simon and Dufour 1998, 2005). Macroinvertebrate multi-habitat samples will also be evaluated using an IBI developed for lowest practical taxonomic level identifications. Specifically, a site will be considered non-supporting for aquatic life use when IBI scores are less than or equal to 35, on a scale of 0 (No Fish) to 60 (Excellent).

#### *6. Specify Tolerable Limits on Decision Errors*

Site specific aquatic life use assessments include program specific controls to minimize the introduction of errors. These controls include water chemistry equipment checks, duplicates, and laboratory controls through verification of species identifications. Field Procedure Manuals (IDEM 2002; OHEPA 2006) and Standard Operating Procedures (IDEM 1992a, IDEM 1992b, 1992c, 1992d, 1992e, 2010a) dictate consistent and proven techniques for sample collection to assure representative samples and minimize measurement error. The QA/QC process detects deficiencies in the data collection as set forth in the IDEM QAPP for the Indiana Surface Water Quality Monitoring Program (IDEM 2004). Samples collected in this project are subject to the QA/QC analysis of 2015 Probabilistic Monitoring Workplan.

#### *7. Optimize the Design for Obtaining Data*

Three Indiana watersheds previously cited on the 303(d) list for impairment(s) that have undergone restoration activities are targeted in this study. These activities will be discussed in a write-up to EPA for reporting watershed improvement, or outlined in a Success Story Document. Sites in the watershed that historically documented the impairment(s) were chosen as sampling sites.

### **Training and Staffing Requirements: (QAPP Element A8)**

The Watershed Assessment and Planning Branch (WAPB) uses many Standard Operating Procedures (SOPs), so any new staff member must be trained by experienced IDEM professionals on how to operate field and laboratory equipment for the collection of chemical, physical, and biological parameters as well as perform required QA/QC procedures (information about SOPs is given in Sections II MEASUREMENT/DATA ACQUISITION and IV DATA VALIDATION and USABILITY). Before sampling starts, IDEM staff spend several days reviewing SOPs with field and laboratory personnel that may be involved with the project.

The fish or macroinvertebrate community field Crew Chief must have a Bachelor of Science degree with a concentration in biology or other closely related area and at least one year of experience with the sampling methodology and taxonomy of the aquatic communities in the region. Prior to conducting electrofishing for fish community sampling, all crew members should review the Principles and Techniques of Electrofishing correspondence course provided by the U.S. Fish & Wildlife Service, National Conservation Training Center as well as test equipment and conduct field training with less experienced crew members. The field Crew Chief will be responsible for completion of field data sheets (Attachments 1-5), taxonomic accuracy, sampling efficiency and representation, and voucher specimen tracking.

Staff from the Technical and Logistical Services Section will review laboratory data for adherence to QA/QC requirements specified in analytical test methods, contract requirements, and the IDEM QAPP for the Indiana Surface Water Quality Monitoring Program (IDEM 2004) as well as importing electronic data into the Assessment Information Management System (AIMSII) database which is used by the WAPB.

Staff will oversee the entry of data collected in the field and laboratory into the AIMSII database and will also perform a data QA/QC review for accuracy and completeness.

## **II. Measurement/Data Acquisition (QAPP Elements B1, B2, B3, B4, B5, B6, B7)**

### **Sampling Sites/Sampling Design: (QAPP Element B1)**

As is described in the “Performance Monitoring in Targeted Watersheds Objective” section of this work plan, the target sites were sampled previously and cited on the 303(d) list of impaired waterbodies.

Site reconnaissance activities are conducted in-house and through physical site visits. In-house activities include preparation and review of site maps and aerial photographs. Physical site visits include verification of accessibility, safety considerations, equipment needed to properly sample the site, and property owner consultations, if required. Final coordinates for each site will be confirmed during the reconnaissance activities for assessing that current conditions have not significantly changed using a Trimble Juno <sup>TM</sup> SB Global Positioning System (GPS) with an accuracy of one to three meters. These coordinates will also be confirmed in the AIMS II database.

Table 4 provides a list of the selected sampling sites with the Site Number, AIMS Site Number, 12-Digit Hydrologic Unit Code (HUC) Name, Stream Name, Location, County, and the Latitude and Longitude of each site. Figures 1 and 2 depict the various sampling site locations for this project.

### **Sampling Methods and Sample Handling: (QAPP Elements B2, B3)**

#### Bacteriological Sampling

The bacteriological sampling will be conducted by one team consisting of two staff. The work effort will require an average of one hour per site per week. Samples will be processed in an IDEM *E. coli* Mobile Laboratory (Van) equipped with all materials and equipment necessary for the Colilert® *E. coli* Test Method near the sampling sites. Five samples from each site (1 site total) will be collected at equally spaced intervals over a thirty day period. Staff will collect the samples in a 120 mL pre-sterilized wide mouth container from the center of flow if stream is wadeable or from the shoreline using a pole sampler if the stream is not wadeable. All samples will be consistently labeled, cooled, and held at a temperature less than 10°C during transport. All *E. coli* samples will be collected on a schedule such that any sampling crew can deliver them to the IDEM *E. coli* Mobile Laboratory for analyses within the bacteriological holding time of six hours.

The IDEM *E. coli* Mobile Laboratory is used in this project to facilitate *E. coli* testing by eliminating the necessity of transporting samples to distant contract laboratories within a six hour holding time. The *E. coli* Mobile Laboratory provides work space containing storage for samples, supplies for Colilert® Quanti-tray testing, and all equipment needed for collecting, preparing, incubating, and analyzing results. All supplies will be obtained from IDEXX Laboratories, Inc., Westbrook, Maine.

#### Water Chemistry Sampling

During three discrete sampling events, one team of two staff will collect water chemistry grab samples record water chemistry field parameter measurements as described below, and note physical site descriptions on the IDEM Stream Sampling Field Data Sheet (Attachment 1). All water chemistry sampling will adhere to the Water Quality Surveys Section Field Procedure Manual (IDEM 2002). Water chemistry sampling is typically completed within 30 minutes per site depending on accessibility.

### **Field Parameter Measurements**

Dissolved Oxygen (DO), pH, water temperature, specific conductance, and DO percent saturation will be measured with a datasonde during each sampling event regardless of the media type being collected. Measurement procedures and operation of the datasonde shall be performed according to the manufacturers' manuals (Hydrolab Corporation 2002; YSI 2002) and Sections 2.10 – 2.13 of the Water Quality Surveys Section Field Procedure Manual (IDEM 2002). Turbidity will be measured with a Hach™ turbidity kit, and the meter number written in the comments under the field parameter measurements. If a Hach™ turbidity kit is not available, the datasonde measurement for turbidity will be recorded. All field parameter measurements and weather codes will be recorded on the IDEM Stream Sampling Field Data Sheet (Attachment 1). A photo will also be taken upstream and downstream of the site during each sampling event.

### **Fish Community Sampling**

The fish community sampling will be completed by teams of three to five staff. Sampling will be performed using various standardized electrofishing methodologies depending on stream size and site accessibility. Fish assemblage assessments will be performed in a sampling reach of 15 times the average wetted width, with a minimum reach of 50 meters and a maximum reach of 500 meters (Simon 1997; Simon and Dufour 1998, 2005; U.S. EPA 1995). An attempt will be made to sample all habitat types available within the sample reach to ensure adequate representation of the fish community present at the time of the sampling event.

If depth and velocity of the stream has not drastically changed, the list of electrofishers to be utilized should nearly match the type of equipment used during the original sampling event which include: the Smith-Root LR-24 or LR-20B Series backpack electrofishers, the Smith-Root model 2.5 Generator Powered Pulsator electrofisher with RCB-6B junction box and a dropper boom array outfitted in a canoe or possibly a 12 foot Loweline™ boat, or for non-wadeable sites the Smith-Root model 6a electrofisher assembled in a 16 foot Loweline™ boat (IDEM 1992a, 1992b, 1992c, 1992d).

Sample collections during high flow or turbid conditions will be avoided due to 1) low collection rates which result in non-representative samples and 2) safety considerations for the sampling team. Sample collections during late autumn and seasonal cold temperatures will be avoided due to the lack of responsiveness to the electrical field by some species that can also result in samples that are not representative of the streams fish assemblage (Simon 1990; U.S. EPA 1995).

Fish will be collected using dip nets with fiberglass handles and netting of 1/8-inch bag mesh. Fish collected in the sampling reach will be sorted by species into baskets and buckets. Young-of-the year fish less than 20 millimeters (mm), total length, will not be retained in the community sample (Simon 1990; U.S. EPA 1995).

Prior to processing fish specimens and completion of the fish collection datasheet (Attachment 2), one to two individuals per species will be preserved in 3.7% formaldehyde solution for future reference if there are more than 10 individuals for that species collected in the sampling reach, the specimens can be positively identified, and the individuals for preservation are small enough to fit in a 2000 mL jar. If however, there are few individuals captured or the specimens are too large to preserve, a photo of key characteristics will be taken for later examination. Taxonomic characteristics for possible species encountered in the basin of interest will be reviewed prior to field work. Fish specimens should also be preserved if they cannot be positively identified in the field (especially those that co-occur like the striped

and common shiner), individuals that appear to be hybrids or have anomalies, as well as dead specimens that are taxonomically valuable for un-described taxa (like the red shiner or jade darter), life history studies, or research projects.

Data will be recorded for non-preserved fish on the fish collection datasheet (Attachment 2) consisting of the following: number of individuals, minimum and maximum total length (mm), mass weight in grams (g), and number of individuals with deformities, eroded fins, lesions, tumors, and other anomalies. Once the data have been recorded, specimens will be released within the sampling reach if possible. Data will be recorded for preserved fish specimens following taxonomic identification in the laboratory.

### Macroinvertebrate Sampling

The macroinvertebrate community sampling may be conducted immediately following the fish community sampling event or on a different date by crews of two to three staff. Samples are collected using a modification of the U.S. EPA Rapid Bioassessment Protocol multi-habitat (MHAB) approach using a D-frame dipnet (Barbour et al. 1999; IDEM 2010a; Klemm et al. 1990; Plafkin et al. 1989). The IDEM MHAB approach is composed of a 1-minute "kick" sample within a riffle or run (collected by disturbing 1 square meter of stream bottom substrate and collecting the dislodged macroinvertebrates within the dipnet) and a 50 meter "sweep" sample of shoreline habitats (collected by disturbing habitats such as emergent vegetation, coarse particulate organic matter, depositional zones, logs and sticks and collecting the dislodged macroinvertebrates within the dipnet).

The 50 meter length of riparian corridor that is sampled at each site will be defined using a rangefinder or GPS unit. If the stream is too deep to wade, a boat will be used to sample the 50 meter zone along the shoreline that has the best available habitat. The 1-minute "kick" and 50 meter "sweep" samples are combined in a bucket of water which will be elutriated through a - U.S. standard number 35 (500 µm) sieve a minimum of five times so that all rocks, gravel, sand and large pieces of organic debris are removed from the sample. The remaining sample is then transferred from the sieve to a white plastic tray where the collector (while still on-site) will conduct a 15-minute pick of macroinvertebrates at a single organism rate with an effort to pick for maximum organism diversity through turning and examination of the entire sample in the tray. The resulting picked sample will be preserved in 70% isopropyl alcohol and returned to the laboratory for identification at the lowest practical taxonomic level (usually genus or species level, if possible) and evaluated using the MHAB macroinvertebrate IBI. Before leaving the site, an IDEM OWQ Macroinvertebrate Header Form (Attachment 3) will be completed for the sample

### Habitat Assessments

Habitat assessments will be completed immediately following macroinvertebrate and fish community sample collections at each site using a slightly modified version of the Ohio Environmental Protection Agency (OHEPA) Qualitative Habitat Evaluation Index (QHEI), 2006 edition (OHEPA 2006; Rankin 1995). A separate QHEI (Attachment 4) must be completed for these two media types since the sampling reach length is different (i.e. 50 meters for macroinvertebrates and between 50 and 500 meters for fish).

## **Analytical Methods: (QAPP Element B4)**

### Bacteriological Sampling

Bacteriological samples will be analyzed using the Standard Method (SM) 9223B Enzyme Substrate Coliform Test Method (see Table 3 for quantification limits). Samples will be collected using 120 mL pre-

sterilized wide mouth containers and adhere to the six hour holding time (Table 5). Analytical results from the IDEM *E. coli* Mobile Laboratory include quality control (QC) check sample results from which precision, accuracy and completeness can be determined for each batch of samples. Raw data are archived by analytical batch for easy retrieval and review. Chain of custody procedures must be followed including time of collection, time of setup, time of reading the results, and time and method of disposal. Any method deviations will be thoroughly documented in the raw data.

All QA/QC samples will be tested according to the following guidelines:

Field Duplicate:	Field Duplicates will be collected at a frequency of 1 per batch or at least 1 for every 20 samples collected ( $\geq 5\%$ ).
Field Blank:	Field Blanks will be collected at a frequency of 1 per batch or at least 1 for every 20 samples collected ( $\geq 5\%$ ).
Laboratory Blank:	Laboratory Blanks (sterile laboratory water blanks) will be tested at a frequency of 1 per day.
Positive Control:	Each lot of media will be tested for performance using bacterial cultures for positive <i>E. coli</i> .
Negative Controls:	Each lot of media will be tested for performance using bacterial cultures for total coliform other than <i>E. coli</i> and a noncoliform.

Quality assurance documentation for each batch of samples consists of a chain of custody form, a QA/QC summary sheet, and spreadsheets of results. This documentation is submitted to the Technical and Logistical Services Section for QA review and the assignment of an appropriate Data Quality Assessment (DQA) Level. Samples collected in this project are subject to the QA/QC analysis of 2015 Probabilistic Monitoring Project.

#### Water Chemistry Data—Nutrients

Sample bottles and preservatives certified for purity will be used. Sample collection container for each parameter/preservative and holding times will adhere to meet U.S. EPA requirements (see Table 5). Field duplicates and matrix spike/matrix spike duplicates (MS/MSD) shall be collected at the rate of one per sample analysis set or one per every 20 samples, whichever is greater. Additionally, field blank samples using ASTM D1193-91 Type I water will be taken at a rate of one set per sampling crew for each week of sampling activity. Nutrient test methods are described in Table 4, page 10. These samples will be collected with the 2015 Probabilistic Monitoring project and analytical tests on the water chemistry parameters will be performed by Pace Analytical Services (formerly Heritage Environmental) in Indianapolis, Indiana.

#### Field Parameters Measurements:

Table 4 lists the field parameters with their respective test method and IDEM quantification limit. During each sampling event, field observations from each site and ambient weather conditions at the time of sampling are noted and documented on the IDEM Stream Sampling Field Data Sheet (Attachment 1). A photo will also be taken upstream and downstream of the site during each sampling event.

**Table 4. Field Parameters showing method and IDEM quantification limit.**

Parameters	Method (SM=Standard Method)	IDEM Quantification Limit
Dissolved Oxygen (data sonde optical)	ASTM D888-09	0.05 mg/L
Dissolved Oxygen (data sonde)	SM 4500-OG	0.03 mg/L
Dissolved Oxygen (Winkler Titration)	SM 4500-OC <sup>1</sup>	0.20 mg/L
Dissolved Oxygen % Saturation (data sonde optical)	ASTM D888-09	0.05 %
Dissolved Oxygen % Saturation (data sonde)	SM 4500-OG	0.01 %
pH (data sonde)	EPA 150.2	0.10 S.U.
pH (field pH meter)	SM 4500H-B <sup>1</sup>	0.10 S.U.
Specific Conductance (data sonde)	SM 2510B	1.00 µmhos/cm
Temperature (data sonde)	SM 2550B(2)	0.1 Degrees Celsius (°C)
Temperature (field meter)	SM 2550B(2) <sup>1</sup>	0.1 Degrees Celsius (°C)
Turbidity (Hach™ turbidity kit)	EPA 180.1	0.05 NTU <sup>2</sup>

<sup>1</sup> Method used for Field Calibration Check

<sup>2</sup> NTU = Nephelometric Turbidity Unit(s)

### Quality Control and Custody Requirements: (QAPP Element B5)

Quality assurance protocols will follow part B5 of the “Quality Assurance Project Plan for the Indiana Surface Water Quality Monitoring and Total Maximum Daily Load (TMDL) Program,” Revision 3, by Timothy Bowren and Dr. Syed Ghiasuddin (IDEM 2004).

The IDEM Biological Samples Field Chain of Custody Form is used to track fish and macroinvertebrate samples from the field to the laboratory (Attachment 5). Fish in the laboratory may be verified by regionally recognized non-IDEM freshwater fish taxonomists. Laboratory identifications and QA/QC of taxonomic work is maintained by the laboratory supervisor of the Probabilistic Monitoring Section of IDEM. All data are 1) checked for completeness 2) calculations performed 3) data entered into the database and 4) checked again for data entry errors.

### Field Instrument Testing and Calibrations: (QAPP Elements B6, B7)

The Datasonde will be calibrated immediately prior to each week’s sampling (IDEM 2002). Calibration results and drift values will be recorded, maintained, stored and archived in log books located in the calibration laboratories at the Shadeland facility. The drift value is the difference between two successive calibrations. Field parameter calibrations will conform to the procedures as described in the instrument users’ manuals (Hydrolab Corporation 2002; YSI 2002). The DO component of the calibration procedure will be conducted using the air calibration method. The unit will be field checked for accuracy once during the week by comparison with a Winkler DO test, as well as Hach™ turbidity, pH and temperature meters. Weekly calibration verification results will be recorded on the stream sampling field data sheets (Attachment 1) and entered into the AIMS II database. A Winkler DO test will also be conducted at sites where the DO concentration is 4.0 mg/L or less.

#### Field Analysis Data

*In situ* water chemistry field data are collected in the field using calibrated or standardized equipment. Calculations may be done in the field or later at the office. Analytical results, which have limited QC checks, are included in this category. Detection limits and ranges have been set for each analysis (Table 4). Quality control checks (such as duplicate measurements, measurements of a secondary standard, or measurements using a different test method or instrument) which are performed on field or laboratory data are usable for estimating precision, accuracy, and completeness for the project.

### **III. ASSESSMENT/OVERSIGHT: (QAPP Elements C1, C2)**

Field and laboratory performance and system audits will be performed to ensure good quality data. The field and laboratory performance includes precision measurements by relative percent difference of field and laboratory duplicate, accuracy measurements by percent of recovery of MS/MSD samples analyzed in the laboratory, and completeness measurements by the percent of planned samples that are actually collected, analyzed, reported, and usable for the project.

#### Data Quality Assessment Levels

The samples and various types of data collected by this program are intended to meet the quality assurance criteria and DQA Levels as described in the WAPB QAPP (IDEM 2004, pp 128-129).

### **IV. DATA VALIDATION and USABILITY: (QAPP Elements D1, D2)**

Quality assurance reports to management and data validation and usability are also important components of the QAPP which insures good quality data for this project. A quality assurance audit report will be submitted for this project should problems arise and need to be investigated and corrected. Data validation and usability will be achieved through data reduction (the process of converting raw analytical data into final results in proper reporting units), data validation (the process of qualifying analytical/ measurement data on the performance of field and laboratory QC measures incorporated into the sampling and analysis procedures), and data reporting (the detailed description of the data deliverables used to completely document the calibration, analysis, QC measures, and calculations).

#### Data Qualifier Flags

The various data qualifiers and flags that will be used for quality assurance and validation of the data are found on pages 130-131 of the WAPB QAPP (IDEM 2004).

#### Data Usability

The environmental data collected and its usability are qualified and classified into one or more of the four categories: Acceptable Data, Enforcement Capable Results, Estimated Data, and Rejected Data as described on page 130 of the WAPB QAPP (IDEM 2004).

#### Information, Data, and Reports

Performance monitoring data that indicates water quality improvement as defined by U.S. EPA's Office of Water's National Water Program Measures WQ-SP12.N11 and WQ-10 will be used to write up Measure W reports and Success Stories to be submitted to U.S. EPA. Additionally, the data will be recorded in the AIMSII database and used in the Indiana Integrated Water Monitoring and Assessment Report. All data and reports will be made available to public and private entities which may find the data useful for municipal, industrial, agricultural, and recreational decision making processes (i.e. TMDL, NPDES permit modeling, Watershed Restoration Projects, Water Quality Criteria refinement, etc.).

### Laboratory and Estimated Cost

Laboratory analysis and data reporting for this project will comply with the QAPP for Indiana Surface Water Quality Monitoring and TMDL Program (IDEM/100/29/338/073/2004, see IDEM 2004), Request For Proposals 12-48 (see IDEM 2012), and the Office of Water Quality Assessment Branch Quality Management Plan (B-001-OWQ-A-00-08-R00, see IDEM 2008a). Analytical tests on the water chemistry parameters Ammonia-N (TKN), Nitrate+Nitrite-N, and Total Phosphorus will be performed by Pace Analytical Services (formerly Heritage Environmental) in Indianapolis, Indiana. Costs for the chemistry samples are \$63.00 per sample. Supplies for the bacteriological sampling will come from IDEXX Laboratories, Inc., Westbrook, Maine. All fish and macroinvertebrate samples will be collected and analyzed by IDEM staff.

*E. coli* on Silver Creek and nutrients on Flowers Creek will be collected by the Probabilistic Monitoring Team and included in their sample count; therefore no additional QA/QC will be included.

### Reference Manuals and Personnel Safety:

All staff who participate in the field component of this study are required to have completed Basic First Aid and Cardio-Pulmonary Resuscitation (CPR) training. According to the memorandum "Change in status of Water Assessment Branch staff in accordance with the Agency training policy" dated November 29, 2010, OWQ Watershed Assessment and Planning Branch staff are exempt from initial and annual training requirements set forth in Section 6.0 of the IDEM Health and Safety Training Policy (IDEM 2010b). The memorandum also states "as an alternative to the training requirements of the policy, the Branch will conduct in-service training at a minimum of four (4) hours per year on topics directly related to duties performed by staff." New hires or those changing job responsibilities without the minimum four hour training must be accompanied in the field by a staff member who has met the requirements of the Branch Health and Safety training.

Field personnel collecting water chemistry and bacteriological samples will follow policies and procedures established in the Surveys Section Field Procedures Manual (IDEM 2002) and the Hazardous Communication Plan Supplement (IDEM 1997). Field personnel collecting fish and macroinvertebrate community samples must read and comply with the Biological Studies Section SOP Manual: Section II. Hazard Communications Manual (IDEM 1992e) which includes four, yellow, 3-ring binders consisting of 1) Safety Manual 2) Hazard Communication and SOP 3) Occupational Safety and Health Administration Handbooks 4) Material Safety Data Sheets as well as "Field and Laboratory Operating Procedures for use, handling and storage of chemicals in the laboratory" (Newhouse 1998a) and "Field and Laboratory Operating Procedures for Use, Handling, and Storage of Solutions Containing Formaldehyde" (Newhouse 1998b). Sampling on surface waters requires safety consciousness of staff members and the use of specialized equipment; thus, staff will comply with the IDEM Personal Protective Equipment (PPE) Policy (IDEM 2008). If an injury or illness arises in the field, staff will follow the IDEM Injury and Illness Resulting from Occupational Exposure Policy (IDEM 2010c). Operating in and around waterbodies carries inherent risks of drowning; thus, personnel involved in sample collection will wear appropriate clothing and PPE when operating boats or sampling in deep water or swift currents. According to the memorandum "Use of Personal Flotation Devices (PFDs) by Branch Personnel" dated February 29, 2000, staff must wear U.S. Coast Guard approved Type I, II, or III PFDs whenever:

- the planned work requires them to enter the water and the maximum water depth at any place at the work site is over their knee (note that this depth depends on the employee but it will usually be between 12 and 20 inches or 300-500 mm) or
- the employee is in a watercraft of any kind that is being launched, is in the water, or is being retrieved from the water or
- the employee must work from structures that do not possess guard rails and are over or alongside water where the water depth is or could reasonably be expected to be 3 feet deep.

In addition, when work is being done in boats on co-jurisdictional waters (as defined by Indiana Code (IC) 14-8-2-315) or during hours of darkness on any waters of the state, all personnel in the watercraft must wear a high intensity whistle and Safety of Life at Sea (SOLAS) certified strobe light.

Safety issues are the responsibility of all crew members; however, any questions in the field should be directed to the field crew leader. The field crew leader is responsible for the completion of all work listed in the workplan, the health and safety aspects of the sampling event, and successful interactions with landowners and members of the public.

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## DISTRIBUTION LIST:

**Electronic Distribution Only:** (QAPP Element A3)

<b><u>Name</u></b>	<b><u>Organization</u></b>
Jody Arthur	OWQ/Watershed Assessment & Planning /Technical E7
Chuck Bell	OWQ/Watershed Assessment & Planning/Technical & Logistics
Timothy Bowren	OWQ/Watershed Assessment & Planning/Technical & Logistics
Angie Brown	OWQ/Watershed Assessment & Planning /Watershed Planning & Restoration
Kevin Crane	OWQ/Watershed Assessment & Planning/Probabilistic Monitoring
Todd Davis	OWQ/Watershed Assessment & Planning/Probabilistic Monitoring
Tim Fields	OWQ/Watershed Assessment & Planning/Probabilistic Monitoring
Cory Fischer	OWQ/Watershed Assessment & Planning/Targeted Monitoring
Kevin Gaston	OWQ/Watershed Assessment & Planning/Probabilistic Monitoring
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Stacey Sobat	OWQ/Watershed Assessment & Planning/Probabilistic Monitoring
Cyndi Wagner	OWQ/Watershed Assessment & Planning/Targeted Monitoring
Kayla Werbianskyj	OWQ/Watershed Assessment & Planning/Targeted Monitoring

**IDEM**

Analysis Set #	EPA Site ID	Rank

**Field Data:**

### Measurement Flags

<	< Min. Meter Measurement
>	> Max. Meter Measurement
E	Estimated (See Comments)
R	Rejected (See Comments)

### Weather Code Definitions

SC Sky Conditions		WD Wind Direction	WS Wind Strength	AT Air Temp
1 Clear	8 Rain	00 North (0 degrees)	0 Calm	1 < 32
2 Scattered	9 Snow	09 East (90 degrees)	1 Light	2 33-45
3 Partly	10 Sleet	18 South (180 degrees)	2 Mod./Light	3 46-60
4 Cloudy		27 West (270 degrees)	3 Moderate	4 61-75
5 Mist			4 Mod./Strong	5 76-85
6 Fog			5 Strong	6 > 86
7 Shower			6 Gale	

**Field Calibrations:**

[illegible]

Calibration Type	pH DO Turbidity
------------------	-----------------------

Preservatives/Bottle Lots:

Preservatives/Bottle Lots:				Groups: Preservatives		Bottle Types	
Group: Preservative	Preservative Lot #	Bottle Type	Bottle Lot #	GC	General Chemistry: Ice	2000P	2000mL Plastic, Narrow Mouth
Nx				Nx	Nutrients: H2SO4	1000P	1000mL Plastic, Narrow Mouth
				Metals	Metals: HNO3	500P	500mL Plastic, Narrow Mouth
				CN	Cyanide: NaOH	250P	250mL Plastic, Narrow Mouth
				O&G	Oil & Grease: H2SO4	1000G	1000mL Glass, Narrow Mouth
				Toxics	Toxics: Ice	500G	500mL Glass, Wide Mouth
				Ecol	Bacteriology: Ice	250G	250mL Glass, Wide Mouth
				VOA	Volatile Organics: HCl & Thiosulfate	125G	125mL Glass, Wide Mouth
				Pest	Pesticides: Ice	400GV	40mL Glass Vial
				Phen	Phenols: H2SO4	120PB	120mL Plastic (Bacteria Only)
				Sed	Sediment: Ice	1000PF	1000mL Plastic, Coming Filter
				Gly	Glyphosate: Thiosulfate	500PF	500mL Plastic, Coming Filter
				Hg	Mercury(1631): HCl	60P	60mL Plastic
				Cr6	Chromium(VI)(1636): NaOH	250T	250mL Teflon
				MeHg	Methyl Mercury(1630): HCl	500T	500mL Teflon
						125T	125mL Teflon

Stream Sampling Field Data Sheet

## Attachment 2. IDEM Fish Collection Data Sheet (front).

### IDEM OWQ-WATERSHED ASSESSMENT AND PLANNING BRANCH

Event ID \_\_\_\_\_ Voucher jars \_\_\_\_\_ Unknown jars \_\_\_\_\_ Equipment \_\_\_\_\_ Page \_\_\_\_\_ of \_\_\_\_\_  
 Voltage \_\_\_\_\_ Time fished (sec) \_\_\_\_\_ Distance fished (m) \_\_\_\_\_ Max. depth (m) \_\_\_\_\_ Avg. depth (m) \_\_\_\_\_  
 Avg. width (m) \_\_\_\_\_ Bridge in reach \_\_\_\_\_ Is reach representative \_\_\_\_\_ If no, why \_\_\_\_\_  
 Elapsed time at site (hh:mm) \_\_\_\_\_: \_\_\_\_\_ Comments \_\_\_\_\_

**Museum data:** Initials \_\_\_\_\_ ID date \_\_\_\_\_ Jar count \_\_\_\_\_ Fish Total \_\_\_\_\_

Coding for Anomalies: D – deformities E – eroded fins L – lesions T – tumor M – multiple DELT anomalies O – other (A – anchor worm C – leeches  
 W – swirled scales Y – popeye S – emaciated F – fungus P – parasites H – heavy L – light (these codes may be combined with above codes)

TOTAL # OF FISH				WEIGHT (s)				ANOMALIES						
				(mass g)				(length mm)						
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												

MKM: Rev/February 19, 2014


**Attachment 2. IDEM Fish Collection Data Sheet (back)**

Event ID \_\_\_\_\_ Page \_\_\_\_\_ of \_\_\_\_\_

								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												

MKM: Rev/February 19, 2014

## Attachment 3. IDEM Office of Water Quality Macroinvertebrate Header Form

 <b>Office of Water Quality: Macroinvertebrate Header</b>																																					
L-Site #	Event ID	Stream Name	Location	County	Surveyor																																
Sample Date	Sample #	Macro#	# Containers	<b>Macro Sample Type:</b> <input type="checkbox"/> Black Light <input type="checkbox"/> Kick <input type="checkbox"/> CPOM <input type="checkbox"/> MHAB <input type="checkbox"/> Hester-Dendy <input type="checkbox"/> Qualitative																																	
<input type="checkbox"/> Habitat Complete <input type="checkbox"/> Sample Quality Rejected		<input type="checkbox"/> Normal _____ <input type="checkbox"/> Duplicate _____ <input type="checkbox"/> Replicate _____																																			
<b>Riparian Zone/Instream Features</b>																																					
<b>Watershed Erosion:</b> <input type="checkbox"/> Heavy <input type="checkbox"/> Moderate <input type="checkbox"/> None		<b>Watershed NPS Pollution:</b> <input type="checkbox"/> No Evidence <input type="checkbox"/> Obvious Sources <input type="checkbox"/> Some Potential Sources																																			
Stream Depth Riffle (m):	Stream Depth Run (m):	Stream Depth Pool (m):	Distances Riffle-Riffle (m):	Distances Bend-Bend (m):																																	
Stream Width (m):		High Water Mark (m):	Velocity (ft/s):																																		
<b>Stream Type:</b> <input type="checkbox"/> Cold <input type="checkbox"/> Warm		<b>Turbidity (Est):</b> <input type="checkbox"/> Clear <input type="checkbox"/> Slightly Turbid <input type="checkbox"/> Opaque <input type="checkbox"/> Turbid		Salinity (mg/L):	ORP (mV):																																
<input type="checkbox"/> Channelization <input type="checkbox"/> Dam Present		<b>Predominant Surrounding Land Use:</b> <input type="checkbox"/> Forest <input type="checkbox"/> Field/Pasture <input type="checkbox"/> Agricultural <input type="checkbox"/> Residential <input type="checkbox"/> Commercial <input type="checkbox"/> Industrial Other: _____																																			
<b>Sediment</b>																																					
<b>Sediment Odors:</b> <input type="checkbox"/> Normal <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Anaerobic <input type="checkbox"/> None Other: _____																																					
<b>Sediment Deposits:</b> <input type="checkbox"/> Sludge <input type="checkbox"/> Sawdust <input type="checkbox"/> Paper Fiber <input type="checkbox"/> Sand <input type="checkbox"/> Relic Shells Other: _____																																					
<b>Sediment Oils:</b> <input type="checkbox"/> Absent <input type="checkbox"/> Moderate <input type="checkbox"/> Profuse <input type="checkbox"/> Slight																																					
<input type="checkbox"/> Are the undersides of stones, which are not deeply embedded, black?																																					
<b>Substrate Components</b>																																					
<small>(Note: Select from 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, or 100% for each inorganic/ organic substrate component)</small>																																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="6">Inorganic Substrate Components (% Diameter)</th> <th colspan="4">Organic Substrate Components (% Type)</th> </tr> </thead> <tbody> <tr> <td>Bedrock</td> <td>Boulder (&gt;10 in)</td> <td>Cobble (2.5-10 in)</td> <td>Gravel (0.1-2.5 in)</td> <td>Sand (gritty)</td> <td>Silt (silty)</td> <td>Clay (silt)</td> <td>Detritus (sticks, wood)</td> <td>Detritus (CPOM)</td> <td>Muck/Mud (black, fine FPOM)</td> <td>Marl(gray w/ shell fragments)</td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>						Inorganic Substrate Components (% Diameter)						Organic Substrate Components (% Type)				Bedrock	Boulder (>10 in)	Cobble (2.5-10 in)	Gravel (0.1-2.5 in)	Sand (gritty)	Silt (silty)	Clay (silt)	Detritus (sticks, wood)	Detritus (CPOM)	Muck/Mud (black, fine FPOM)	Marl(gray w/ shell fragments)											
Inorganic Substrate Components (% Diameter)						Organic Substrate Components (% Type)																															
Bedrock	Boulder (>10 in)	Cobble (2.5-10 in)	Gravel (0.1-2.5 in)	Sand (gritty)	Silt (silty)	Clay (silt)	Detritus (sticks, wood)	Detritus (CPOM)	Muck/Mud (black, fine FPOM)	Marl(gray w/ shell fragments)																											
<b>Water Quality</b>																																					
<b>Water Odors:</b> <input type="checkbox"/> Normal <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> None Other: _____																																					
<b>Water Surface Oils:</b> <input type="checkbox"/> Slick <input type="checkbox"/> Sheen <input type="checkbox"/> Glob <input type="checkbox"/> Flocks <input type="checkbox"/> None																																					

IDEM 03/14/13



## Attachment 4 (continued). IDEM OWQ Biological QHEI (back).

IDEM					OWQ Biological QHEI (Qualitative Habitat Evaluation Index)	
COMMENT						
<div> <div> <b>A-CANOPY</b>  <input type="checkbox"/> &gt; 85% - Open  <input type="checkbox"/> 55% - &lt; 85%  <input type="checkbox"/> 30% - &lt; 55%  <input type="checkbox"/> 10% - &lt; 30%  <input type="checkbox"/> &lt; 10% - Closed </div> <div> <b>B-AESTHETICS</b>  <input type="checkbox"/> Nuisance algae  <input type="checkbox"/> Invasive macrophytes  <input type="checkbox"/> Excess turbidity  <input type="checkbox"/> Discoloration  <input type="checkbox"/> Foam/Scum </div> <div> <input type="checkbox"/> Oil sheen  <input type="checkbox"/> Trash/Litter  <input type="checkbox"/> Nuisance odor  <input type="checkbox"/> Sludge deposits  <input type="checkbox"/> CSOs/SSOs/Outfalls </div> <div> <b>C-RECREATION</b>            Area      Depth            Pool: <input type="checkbox"/> &gt; 100 ft<sup>2</sup>   <input type="checkbox"/> &gt; 3 ft </div> <div> <b>D-MAINTENANCE</b>  <input type="checkbox"/> Public   <input type="checkbox"/> Private  <input type="checkbox"/> Active   <input type="checkbox"/> Historic            Succession: <input type="checkbox"/> Young   <input type="checkbox"/> Old  <input type="checkbox"/> Spray   <input type="checkbox"/> Islands   <input type="checkbox"/> Scoured            Snag: <input type="checkbox"/> Removed   <input type="checkbox"/> Modified            Levees: <input type="checkbox"/> One-sided   <input type="checkbox"/> Both banks  <input type="checkbox"/> Relocated   <input type="checkbox"/> Cutoffs            Bedload: <input type="checkbox"/> Moving   <input type="checkbox"/> Stable  <input type="checkbox"/> Armoured   <input type="checkbox"/> Skumps  <input type="checkbox"/> Impounded   <input type="checkbox"/> Desiccated  <input type="checkbox"/> Flood control   <input type="checkbox"/> Drainage </div> <div> <b>E-ISSUES</b>  <input type="checkbox"/> WWTP   <input type="checkbox"/> CSO   <input type="checkbox"/> NPDES  <input type="checkbox"/> Industry   <input type="checkbox"/> Urban  <input type="checkbox"/> Hardened   <input type="checkbox"/> Dirt &amp; Grime  <input type="checkbox"/> Contaminated   <input type="checkbox"/> Landfill            BMPs: <input type="checkbox"/> Construction   <input type="checkbox"/> Sediment  <input type="checkbox"/> Logging   <input type="checkbox"/> Irrigation   <input type="checkbox"/> Cooling            Erosion: <input type="checkbox"/> Bank   <input type="checkbox"/> Surface  <input type="checkbox"/> False bank   <input type="checkbox"/> Manure   <input type="checkbox"/> Lagoon  <input type="checkbox"/> Wash H<sub>2</sub>O   <input type="checkbox"/> Tile   <input type="checkbox"/> H<sub>2</sub>O Table            Mines: <input type="checkbox"/> Acid   <input type="checkbox"/> Quarry            Flow: <input type="checkbox"/> Natural   <input type="checkbox"/> Stagnant  <input type="checkbox"/> Wetland   <input type="checkbox"/> Park   <input type="checkbox"/> Golf  <input type="checkbox"/> Lawn   <input type="checkbox"/> Home  <input type="checkbox"/> Atmospheric deposition  <input type="checkbox"/> Agriculture   <input type="checkbox"/> Livestock </div> </div>						
Looking upstream (> 10m, 3 readings; ≤ 10m, 1 reading in middle): Round to the nearest whole percent						
% open	Right %	Middle %	Left %	Total Average %		
	X	X	X			
Stream Drawing:						

[illegible]

## Appendix 1. IDEM Fish Community Assessments for Aquatic Life Use

IDEM collects fish along with other data (chemical parameters, nutrients, macroinvertebrate, and habitat) to monitor the health of streams and rivers in Indiana. There are many advantages of using fish for monitoring stream health:

- Many fish have life spans of greater than 3 years allowing detection of degradation in habitat or water chemistry over time which will alter the expected fish community structure.
- The knowledge of fish life history, feeding and reproductive behavior is well known and can be used to detect changes in water chemistry or habitat alterations.
- Identification of fish species can usually be made in the field so that fish are returned to the stream and time for laboratory identifications kept minimal.

The Indiana Administrative Code [327 IAC 2-1-3(2)] has narrative biological criteria that states “all waters, except those designated as limited use, will be capable of supporting a well-balanced, warm water aquatic community.” The water quality standard definition of a “well-balanced aquatic community” is “an aquatic community which is diverse in species composition, contains several different trophic levels, and is not composed mainly of pollution tolerant species” [327 IAC 2-1-9(59)]. To measure whether or not the fish community is meeting this definition, IDEM uses an Index of Biotic Integrity (IBI) which is composed of 12 fish community characteristics chosen based on what part of the state you are sampling (ecoregion) and size of stream (drainage area). The 12 different characteristics can score a 0, 1, 3, or 5 which represents the deviation from expected fish community structure (i.e. 5 = no deviation from expectations, 1 = severe deviation from expected fish community structure). The total score can range from 0 (no fish) to 60 (excellent, comparable to “least impacted” conditions). Indiana expects streams to score at least 36 out of 60 to meet aquatic life use water quality standards. The chart below, modified from a table developed by Karr et al. 1986, uses total IBI score, integrity class and attributes to define the fish community characteristics in Indiana streams and rivers.

Total IBI Score	Integrity Class	Attributes
53-60	Excellent	Comparable to “least impacted” conditions, exceptional assemblage of species.
45-52	Good	Decreased species richness (intolerant species in particular), sensitive species present.
36-44	Fair	Intolerant and sensitive species absent, skewed trophic structure.
23-35	Poor	Top carnivores and many expected species absent or rare, omnivores and tolerant species dominant.
12-22	Very Poor	Few species and individuals present, tolerant species dominant, diseased fish frequent.
<12	No Fish	No fish captured during sampling.

Karr, J.R., K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.J. Schlosser. 1986. Assessing biological integrity in running waters: a method and its rationale. Illinois Natural History Survey Special Publication 5. 28 p.

Some examples of metrics and fish specimens for the Index of Biotic Integrity (IBI) looking at species composition, trophic levels, and tolerance to water pollution or habitat disturbance.

1. Number of Species (generally more species = better quality stream)
2. Number of Darter, Madtom, Sculpin Species (species require high dissolved oxygen and clean rocky substrates so higher number = better quality stream)
  - Examples: rainbow darter, brindled madtom, mottled sculpin

% Large River Individuals (species require habitats typical in great rivers in terms of bottom substrates, current velocity, backwater areas, etc. so higher percentage = better quality river)

- Examples: chestnut lamprey, channel catfish, bullhead minnow, silver chub
3. % Headwater Individuals (species in small streams occupying permanent habitat with low environmental stress so greater percentage = better quality stream)
    - Examples: western blacknose dace, southern redbelly dace, fantail darter

Number of Sunfish or Centrarchidae Species (species occupy pools which act as “sinks” for potential pollutants and silt so fewer number of these species = low quality stream)

- Examples: rock bass, bluegill, largemouth bass

4. Number of Sucker or Round Body Sucker Species (species do not tolerate habitat and water quality degradation so more = better quality stream)

- Examples: black redhorse, northern hog sucker

Number of Minnow Species (generally more minnow species = better quality stream)

- Examples: spotfin shiner, silverjaw minnow, hornyhead chub

5. Number of Sensitive Species (species sensitive to pollution so more species = better quality stream)

- Examples: greenside darter, smallmouth bass, longear sunfish

6. % Tolerant Individuals (species tolerant to pollution so greater percentage = low quality stream)

- Examples: yellow bullhead, green sunfish, central mudminnow

7. % Omnivore/Detritivore Individuals (species that consume at least 25% plant and 25% animal material which makes them opportunistic feeders when other food sources are scarce; thus, greater percentage = lower quality stream)

- Examples: bluntnose minnow, white sucker, gizzard shad

8. % Insectivore/Invertivore Individuals (species whose diet is mainly benthic insects so the metric is a reflection of the food source; thus, lower percentage = lower quality stream)

- Examples: blackstripe topminnow, emerald shiner, logperch

9. % Carnivore Individuals (species whose diet is carnivorous and also reflects the availability of the food source; too high or too low percentage of carnivores = lower quality stream and imbalance of trophic levels)

- Examples: spotted bass, grass pickerel

% Pioneer Individuals (species that are first to colonize a stream after environmental disturbance so higher percentage of pioneer individuals = lower quality stream)

- Examples: creek chub, central stoneroller, johnny darter

10. Number of Individuals (generally more individuals = better quality stream)
11. % Simple Lithophilic Individuals (species that require clean gravel or cobble for successful reproduction since they simply broadcast their eggs on the substrate, fertilize, and provide no parental care; thus, heavy siltation or environmental disturbance will result in a lower percentage of simple lithophilic species = lower quality stream)
  - Examples: bigeye chub, striped shiner, orangethroat darter
12. % Individuals with Deformities, Eroded Fins, Lesions, and Tumors (DELT's) (diseased individuals with external anomalies as a result of bacterial, fungal, viral, and parasitic infections, chemical pollutants, overcrowding, improper diet, and other environmental degradation. Percentages should be absent or very low naturally so higher percentage = low quality stream)
  - Examples: deformed blackstripe topminnow, creek chub with tumors

## Appendix 2. Calculating IDEM Macroinvertebrate Index of Biotic Integrity (mIBI)

The purpose of this document is to describe the laboratory processing and data analysis procedures used by the Indiana Department of Environmental Management (IDEM) to calculate the macroinvertebrate Index of Biotic Integrity (mIBI). Standard Operating Procedures (SOPs) are being developed to describe these processes but it may be some time before they are finalized.

A SOP describing the methods used by IDEM to collect macroinvertebrate samples with a multi-habitat (MHAB) sampling method was recently completed (available at <http://monitoringprotocols.pbworks.com/f/S-001-OWQ-W-BS-10-S-R0.pdf>). The index period for collection of macroinvertebrate samples with the MHAB sampling method is July 15th to October 30th. The entire sample is processed in the laboratory as subsampling has already been performed in the field. All macroinvertebrate individuals are counted with the exception of empty snail and clam shells, microcrustaceans (Ostracoda, Branchiopoda, Copepoda), larval and pupal insect exuviae, and terrestrial insects (including the terrestrial adults of aquatic insect larvae); invertebrate specimens missing their head are also excluded. The level of taxonomic resolution used in the identification of macroinvertebrates may depend in large part on the condition (instar and physical condition) of the specimens and the availability of taxonomic resources that are comprehensive and appropriate for Indiana's fauna. Specimens are generally identified to the "lowest practical" taxonomic level. Oligochaeta (aquatic worms, Hirudinea and Branchiobdellida), Planaria and Acari are only identified to family or a higher level; freshwater snails and clams are identified to genus; freshwater crustacea are identified to genus (Amphipoda and Isopoda) or species (Decapoda); aquatic insects are identified to family (Collembola and several Dipteran families) or genus and species (all other insects). The following table lists insect genera that are often identified to species (and may contain multiple species in a sample) and taxonomic resources commonly used by IDEM biologists for their identification (full citations for these resources are listed in the Taxonomic References at the end of this document).

### Ephemeroptera:

Baetidae: *Baetis* (separate *B. intercalaris* and *B. flavistriga* with Moriharra and McCafferty 1979, leave everything else at *Baetis*)

Caenidae: *Caenis*: Provonsha 1990

Heptageniidae: *Mccaffertium* (formerly *Stenonema* subgenus *Mccaffertium*): Bednarik and McCafferty 1979

### Odonata:

Gomphidae: *Dromogomphus*: Westfall and Tennesen 1979

Coenagrionidae: *Argia* and *Enallagma*: Westfall and May 1996

### Hemiptera:

Corixidae: *Trichocorixa* and *Palmacorixa*: Hungerford 1948, Hilsenhoff 1984

### Megaloptera:

Corydalidae: *Chauliodes* and *Nigronia*: Rasmussen and Pescador 2002

### Coleoptera:

Halipidae: *Peltodytes*: Brigham 1996

Dytiscidae: *Neoporus*, *Heterosternuta*, *Laccophilus*, *Coptotomus*: Larson et al. 2000.

Hydrophilidae: *Tropisternus*, *Berosus*, *Enochrus*: Hilsenhoff 1995A and 1995B.

Elmidae: *Stenelmis*, *Dubiraphia*, *Optioservus*: Hilsenhoff and Schmude, Hilsenhoff 1982

### Trichoptera:

Philopotamidae: *Chimarra*: Hilsenhoff 1982

Leptoceridae: *Nectopsyche*: Glover and Floyd 2004

Hydropsychidae: *Hydropsyche*: Schuster and Etnier 1978

### Diptera:

Chironomidae: *Ablabesmyia*: Roback 1985 (sub-genus/ species group)

*Polypedilum*: Maschwitz and Cook 2000 (sub-genus/ species group)

*Cricotopus/Orthocladius*: Merritt et al 2007 (sub-genus/ species group)

After all organisms in the sample have been identified to the lowest practical taxon, those taxa are then associated with their corresponding tolerance, functional feeding group and habit values (found in the spreadsheet "Indiana Macroinvertebrate Attributes"). Organisms without a tolerance value, functional feeding group or habit are not included in the calculations for those specific metrics (this may become more evident while looking at the metric example on page 3). For taxa metrics, all of the taxa listed for a specific group (EPT, Diptera) are counted, regardless of level of identification (i.e., if there were 4 taxa under the Chironomidae family (1 family level ID, 1 *Cricotopus* genus level ID, and 2 distinct species level IDs under the *Cricotopus* genus) this would be considered 4 taxa).

The metrics are then calculated as follows:

- 1 - Total Number of Taxa: Numerical count of all identified taxa in the sample
- 2 - Total Number of Individuals: Numerical count of the number of individual specimens in the sample
- 3 - Total Number of EPT Taxa: Numerical count of all Ephemeroptera, Plecoptera and Trichoptera taxa in the sample
- 4 - Total Number of Diptera Taxa: Numerical count of all Diptera taxa in the sample
- 5 - % Orthoclaadiinae + Tanytarsini of Chironomidae: Number of individuals in the chironomid subfamily Orthoclaadiinae and tribe Tanytarsini divided by the total number of Chironomidae in the sample
- 6 - % Non-insect (minus crayfish): Number of individuals, except for crayfish, that are not in the Class Insecta (Isopoda, Amphipoda, Acari, snails, freshwater clams, Oligochaeta, Nematoda, Nematomorpha) divided by the total number of individuals in the sample
- 7 - % Intolerant: Number of individuals with a tolerance value of 0-3 divided by the total number of individuals in the sample
- 8 - % Tolerant: Number of individuals with a tolerance value of 8-10 divided by the total number of individuals in the sample
- 9 - % Predators: Number of individuals with a functional feeding group designation of "Predator" divided by the total number of individuals in the sample
- 10 - % Shredders + Scrapers: Combined number of individuals in the functional feeding groups "Shredder" and "Scraper" divided by the total number of individuals in the sample
- 11 - % Collector-Filterers: Number of individuals in the functional feeding group "Collector-Filterer" divided by the total number of individuals in the sample
- 12 - % Sprawlers: Number of individuals with a habit specificity of "Sprawler" divided by the total number of individuals in the sample

These metric values are then scored as a 1, 3 or 5 according to the criteria in the following table:

Metric	1	3	5
Number of Taxa	< 21	≥ 21 and < 41	≥ 41
Number of Individuals	< 129	≥ 129 and < 258	≥ 258
Number of EPT Taxa			
Drainage Area: < 5 mi <sup>2</sup>	< 2	≥ 2 and < 4	≥ 4
Drainage Area: ≥ 5 and < 50 mi <sup>2</sup>	< 4	≥ 4 and < 8	≥ 8
Drainage Area: ≥ 50 mi <sup>2</sup>	< 6	≥ 6 and < 12	≥ 12
% Orthoclaadiinae + Tanytarsini of Chironomidae	≥ 47	≥ 24 and < 47	< 24
% Non-insects Minus Crayfish	≥ 35	≥ 18 and < 35	< 18
Number of Diptera Taxa	< 7	≥ 7 and < 14	≥ 14
% Intolerant	< 15.9	≥ 15.9 and < 31.8	≥ 31.8
% Tolerant	≥ 25.3	≥ 12.6 and < 25.3	< 12.6
% Predators	< 18	≥ 18 and < 36	≥ 36
% Shredders + Scrapers	< 10	≥ 10 and < 20	≥ 20
% Collector-Filterers	≥ 20	≥ 10 and < 20	< 10
% Sprawlers	< 3	≥ 3 and < 6	≥ 6

Most scoring classifications are the same regardless of stream drainage area; the exception is the "Number of EPT Taxa" metric which increases with increasing drainage area. After all metrics have been scored, the individual metric scores are summed and the total is the mIBI score for that particular site. Scores less than 36 are considered impaired while those greater than or equal to 36 are unimpaired.

#### Example of Derivation of Metric Scores for the Macroinvertebrate Index of Biotic Integrity

TAXA NAME	FEED GRP	TOL	HAB/BHV	# OF IND
<i>Heptagenia</i>	SC	3		1
<i>Leucrocuta</i>	SC	2	cn	1
<i>Acerpenna pygmaea</i>	OM	2	sw	1
<i>Baetis flavistriga</i>	GC	3	sw	1
<i>Callibaetis</i>	GC	6	sw	1
<i>Ephemera simulans</i>				1
<i>Ischnura verticalis</i>	PR			1
<i>Berosus peregrinus</i>	SH	6	sw	1
<i>Dubiraphia</i>	GC	5	cn	1
<i>Macronychus glabratus</i>	OM	3	cn	1
<i>Ceratopsyche bronta</i>		5		1
<i>Pycnopsyche</i>	SH	3	sp	1
<i>Chrysops</i>	GC	5		1
<i>Procladius</i>	PR	7	sp	1
<i>Paraphaenocladus</i>	GC		sp	1
<i>Lirceus</i>	GC	8	cr	1
<i>Ferrissia rivularis</i>	SC	6		1
<i>Physella</i>	SC	8		1
<i>Corbicula fluminea</i>	FC	6		1
NAIDIDAE	GC	8		1
Acariformes		4		1
<i>Maccaffertium pulchellum</i>	SC	2		2
<i>Tricorythodes</i>	GC	3	sw	2
<i>Boyeria vinosa</i>	PR	4	cb	2
<i>Rheumatobates</i>	PR		sk	2
<i>Trepobates</i>	PR			2
<i>Stenelmis</i>	SC	5	cn	2
<i>Polypedilum flavum</i>				2
<i>Stictochironomus</i>	OM	4	bu	2
<i>Caenis latipennis</i>	GC			3
<i>Palmarixia nana</i>	PI	4	sw	3
<i>Cheumatopsyche</i>	FC	3	cn	3
<i>Orconectes</i>	GC	4		3
<i>Hetaerina americana</i>	PR			4
<i>Ancyronyx variegatus</i>	OM	4		5
<i>Baetis intercalaris</i>	OM	3	sw	6
<i>Peltodytes duodecimpunctata</i>				6
<i>Trepobates inermis</i>				7
<i>Dubiraphia minima</i>				7
<i>Hyalella azteca</i>	GC	8	cr	9
<i>Polypedilum illinoense</i>		7		16

<b><i>Stenelmis sexlineata</i></b>				<b>18</b>
<b>Grand Total</b>				127
<b>Metrics</b>	<b>Metric Values</b>	<b>Metric Scores</b>		
Total Number of Taxa	42	<b>3</b>		
Total Abundance of Individuals	127	<b>1</b>		
Number of EPT Taxa	13	<b>5</b>		
% Orthocladinae + Tanytarsini of Chironomidae	4.55	<b>5</b>		
% Non-Insects - Crayfish	11.81	<b>5</b>		
Number of Diptera Taxa	6	<b>1</b>		
% Intolerant Taxa (Score 0 - 3)	14.96	<b>1</b>		
% Tolerant Taxa (Score 8 - 10)	9.45	<b>5</b>		
% Predators	9.45	<b>1</b>		
% Shredders + Scrapers	7.87	<b>1</b>		
% Collector-Filterers	3.15	<b>5</b>		
% Sprawlers	2.36	<b>1</b>		
<b>MIBI Score</b>		<b>34</b>		

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